

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kulbinder K. Banger et al.
Title: SINGLE SOURCE PRECURSORS FOR TERNARY
CHALCOPYRITE MATERIALS, AND METHODS OF MAKING AND
USING THE SAME
Serial No.: 10/698,118 Art Unit: not yet assigned
Filed: October 31, 2003 Examiner: not yet assigned
Docket: 35089US1

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with 37 C.F.R. § 1.98, applicant is submitting herewith Form PTO-1449 listing references for consideration by the Examiner. Also submitted herewith is a legible copy of each reference listed.

If any further fees are required by this communication, please charge such fees to our Deposit Account No. 16-0820, Order No. 35089US1.

Respectfully submitted,
PEARNE & GORDON LLP

By 
Steven J. Solomon, Reg. No. 48719

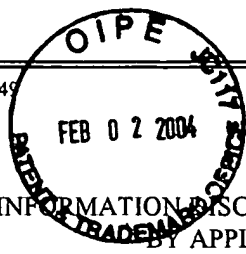
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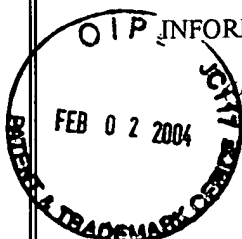
		Document No.	Date	Country	Class	Subclass	Translation
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OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

E	Contreas, M., et al., "Progress Toward 20% Efficiency in Cu(In,Ga)Se ₂ Polycrystalline Thin-Film Solar Cells", <i>Prog. Photovolt. Res. App.</i> , 1999, 7, pgs. 311-316.
F	Hoffinan, D., et al., "Thin-Film Solar Array Earth-Orbit Mission Applicability Assessment", <i>XVII Space Photovoltaic Research and Tech. Conf.</i> , 2001.
G	Bailey, S.G., et al., "Space Photovoltaics", <i>Prog. Photovolt. Res. App.</i> , 1998, 6, 1-14.
H	Schock, H.W., et al., "Development of CIS Solar Cells for Space Applications", Eds. Schmid, J., et al., <i>2nd World Photovolt. Solar Energy Conf.</i> , Vienna, 1998, pgs. 1-4.
I	Tarrant, D., et al., "I-III-VI ₂ Multinary Solar Cells Based on CuInSe ₂ ", <i>Proc. 23rd IEEE Photovoltaic Specialist Conference</i> , 1993, ABSTRACT.
J	Basol, B.M., et al., "Cu(In,Ga)Se ₂ Thin Films and Solar Cells Prepared by Selenization of Metallic Precursors", <i>J. of Vacuum Science and Technology A</i> , 1996, 14A, pgs. 2251-2256.
K	Probst, V., et al., "Rapid CIS-Process for High Efficiency PV-Modules: Development Towards Large Area Processing", <i>Thin Solid Films</i> , 2001, 387, pgs. 262-267.
L	Dimmler, B., et al., "Scalability and Pilot Operation in Solar Cells of CuInSe ₂ and Their Alloys", <i>Prog. Photovolt. Res. Appl.</i> , 1998, 6, pgs. 193-199.

Examiner:	Date Considered
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OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

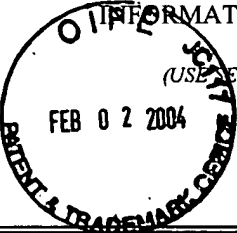
	E	Park, S.C., et al., "Fabrication of CuInSe ₂ Films and Solar Cells by the Sequential Evaporation of In ₂ Se ₃ and Cu ₂ Se Binary Compounds", <i>Sol. Energy Mater. Sol. Cells</i> , 2001, 69, pgs. 99-105.
	F	Guillen, C., et al. "Recrystallization and Components Redistribution Processes in Electrodeposited CuInSe ₂ Thin Films", <i>Thin Solid Films</i> , 2001, 387, pgs. 57-59.
	G	Eberspacher, C., et al., "Thin-Film CIS Alloy PV Materials Fabricated Using Non-Vacuum, Particles-Based Techniques", <i>Thin Solid Films</i> , 2001, 387, pgs. 18-22.
	H	Klenk, M., et al., "Properties of Flash Evaporated Chalcopyrite Absorber Films and Solar Cells", <i>Thin Solid Films</i> , 2001, 387, pgs. 47-49.
	I	Dzionk, C., et al., "Phase Formation During the Reactive Annealing of Cu-In Films in H ₂ S Atmosphere", <i>Thin Solid Films</i> , 1997, 299, pgs. 38-44.
	J	Krunk, M., et al., "Composition and Structure of CuInS ₂ Films Prepared by Spray Pyrolysis", <i>Thin Solid Films</i> , 2000, 361-2, pgs. 61-64.
	K	Artaud, M.C., et al., "CuInSe ₂ Thin Films Grown by MOCVD: Characterization, First Devices", <i>Thin Solid Films</i> , 1998, 324, pgs. 115-123.
	L	Jones, A.C., et al., "CVD of Compound Semiconductors: Precursors Synthesis, Development & Application", <i>VCH Press</i> , 1997, pgs. 42-99.
	M	Nomura, R., et al., "Preparation of Copper-Indium-Sulfide Thin Films by Solution Pyrolysis of Organometallic Sources", <i>Chem. Let.</i> , 1988, pgs. 1849-1850.

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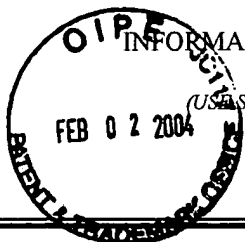
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		Document No.	Date	Country	Class	Subclass	Translation
	D						

OTHER REFERENCES <i>(Including Author, Title, Date, Pertinent Pages, Etc.)</i>		
	E	Nomura, R., et al., "Oxygen-or Sulphur-Containing Organoindium Compounds for Precursors of Indium Oxide and Sulphide Thin Films", <i>Polyhedron</i> , 1990, 9, pgs. 361-366.
	F	Nomura, R., et al., "Preparation of CuInS ₂ Thin Films by Single-Source MOCVD Process Using Bu ₂ In(SPr)Cu(S ₂ CNPri ₂)", <i>J. Mater. Chem.</i> , 1992, pgs. 765-766.
	G	Nomura, R., et al., "Preparation of CuIn ₃ S ₈ Thin Films by Single-Source Organometallic Chemical Vapour Deposition", <i>Thin Solid Films</i> , 1992, 209, pgs. 145-147.
	H	Hirpo, W., et al., "Synthesis of Mixed Copper-Indium Chalcogenolates. Single Source Precursors for the Photovoltaic Material CuInQ ₂ (Q = S, Se), <i>J. Am. Chem. Soc.</i> , 1993, 115, pgs. 1597-1599.
	I	Hollingsworth, J.A., et al., "Spray CVD of Copper Indium Disulfide Films: Control of Microstructure and Crystallographic Orientation", <i>Chem. Vap. Deposition</i> , 1999, 5, pgs. 105-108.
	J	Hollingsworth, J.A., et al., "Spray Chemical Vapor Deposition of CuInS ₂ Thin Films for Application in Solar Cell Devices", <i>Mat. Res. Soc. Symp. Proc.</i> , 1998, 495, ABSTRACT.
	K	Harris, J.D., et al., "Using Single Source Precursors and Spray Chemical Vapor Deposition to Grow Thin-Film CuInS ₂ ", <i>Proc. of the 28th IEEE Photovoltaic Specialists Conference</i> , 2000, ABSTRACT
	L	Banger, Kulbinder K., et al., "Synthesis and Characterization of the First Liquid Single-Source Precursors for the Deposition of Ternary Chalcopyrite (CuInS ₂) Thin Film Materials", <i>Chem. Mater.</i> , 2001, 13(11), pgs. 3827-3829.

Examiner:	Date Considered
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FOREIGN PATENT DOCUMENTS

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	D						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

E	Hollingsworth, J.A., "Chemical Routes to Nanocrystalline and Thin-Film III-VI and I-III-VI Semiconductors", Dissertation, Washington University, 1999.
F	Drago, R.S., et al., "E and C Parameters from Hammett Substituent Constants and Use of E and C to Understand Cobalt-Carbon Bond Energies", <i>Inorg. Chem.</i> , 1987, 26, pgs. 9-14.
G	Riga, A. et al., "Process Development and Synthesis of CuInSe ₂ and CuInS ₂ Precursors of Chemical Vapor Deposition Aided by Thermal Analytical Techniques", <i>NATAS Annual Conference on Thermal Analysis Applications</i> , 2001, ABSTRACT.
H	Hollingsworth, J.A., et al., "Single Source Precursors for Fabrication of I-III-VI ₂ Thin-Film Solar Cells Via Spray CVD", <i>Thin Solid Films</i> , 2003, 431-432, pgs. 63-67.
I	Banger, K.K., et al., "A Review of Single Source Precursors for the Deposition of Ternary Chalcopyrite Materials", <i>NASA Conference Publication</i> (2002), (<i>17th Space Photovoltaic Research and Technology Conference</i> , 2001), pgs. 115-125.
J	Deivaraj, T.C., et al., "Novel Bimetallic Thiocarboxylate Compounds as Single-Source Precursors to Binary and Ternary Metal Sulfide Materials", <i>Chemistry of Materials</i> , 2003, 15(12), pgs. 2383-2391.

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		Document No.	Date	Country	Class	Subclass	Translation
	D						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)

E	Jin, M. H., et al., "Thin Film CuInS ₂ Prepared by Spray Pyrolysis with Single-Source Precursors", <i>Conference Record of the IEEE Photovoltaic Specialists Conference</i> , 2002, 29 th , ABSTRACT.
F	Afzaal, M., et al., "New Approach Towards the Deposition of I-III-VI Thin Films", <i>Materials Research Society Symposium Proceedings</i> , 2002, pgs. 185-190.
G	Banger, K.K., et al., "Ternary Single-Source Precursors for Polycrystalline Thin-Film Solar Cells", <i>Applied Organometallic Chemistry</i> , 2002, 16(11), pgs. 617-627.
H	Banger, K.K., et al., "Facile Modulation of Single Source Precursors: The Synthesis and Characterization of Single Source Precursors for Deposition of Ternary Chalcopyrite Materials", <i>Thin Solid Films</i> , 2002, 403-404, 390-395.
I	Deivaraj, T.C., et al., "Single-Source Precursors to Ternary Silver Indium Sulfide Materials", <i>Chemical Communications</i> , 2001, 22, pgs. 2304-2305.
J	Banger, Kulbinder K., et al., "Facile Modulation and Preparation of Single Source Precursors for Low-Temperature Deposition of Ternary Chalcopyrite Materials", <i>Abstracts of Papers, 222nd ACS National Meeting</i> , August 26-30, 2001, <i>American Chemical Society</i> , ABSTRACT.
K	Deivaraj, C.T., et al., "Synthesis and Structure of [(Ph ₃ P) ₂ Ag(μ-Cl)(μ-SC(O)Ph)In(SC(O)Ph) ₂]", <i>Inorganica Chimica Acta</i> , 336, 2002, pgs. 111-114.

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	D						

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)		
	E	Harris, J.D., et al., "Characterization of CuInS ₂ Films Prepared by Atmospheric Pressure Spray Chemical Vapor Deposition", <i>Materials Science & Engineering</i> , 2003, B98(2), pgs. 150-155.
	F	Shibata, J., et al., "Transmission Electron Microscopic Studies of LiNb _{0.5} Ta _{0.5} O ₃ Films Deposited on Sapphire Substrates by Thermal Plasma Spray CVD (Microstructure of LiNb _{0.5} Ta _{0.5} O ₃ Films Deposited by Thermal Plasma Spray CVD)", <i>Materials Transactions</i> , 2002, 43(7), ABSTRACT.
	G	Henderson, D., "Optical and Structural Characterization of Copper Indium Disulfide Thin Films", <i>Materials & Design</i> , 2001, 22(7), pgs. 585-589.
	H	Vittal, J.J., et al., "Group 11 and 13 Metal Thiocarboxylate Compounds as Single Source Molecular Precursor for Bulk Metal Sulfide Materials and Thin Films", <i>Progress in Crystal Growth and Characterization of Materials</i> , 2002, pgs. 21-27.
	I	Jin, M.H.C., et al., "The Effect of Film Composition on the Texture and Grain Size of CuInS ₂ Prepared by Chemical Spray Pyrolysis", <i>Mat. Res. Soc. Symp. Proc.</i> , Vol. 763, 2003, pgs. B8.23.1-B8.23.6.
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